3. Urbanski PP. Valve-preserving aortic root reconstruction [Letter]. *J Thorac Cardiovasc Surg*. 2001;121:1220.
4. Urbanski PP. Valve-sparing aortic root repair with patch technique. *Ann Thorac Surg*. 2005;80:839-44.
5. Urbanski PP, Zhan X, Frank S, Diegeler A. Aortic root reconstruction using new vascular graft. *Interact Cardiovasc Thorac Surg*. 2009;8:187-90.
6. Urbanski P. Basal cusp enlargement for repair of aortic valve insufficiency. *J Thorac Cardiovasc Surg*. 2010;139:98-102.
7. Urbanski P. Aortic valve insufficiency with extensive cusp pathology: repair with a pericardial patch. *Eur J of Cardiothorac Surg*. 2010;37:962-4.
8. Tubrikar MJ, Labrosse MR, Zehr KJ, Robicsek F. Aortic root dilatation may alter the dimensions of the valve leaflets. *Eur J Cardiothorac Surg*. 2005;28: 850-6.
9. Labrosse MR, Beller CJ, Robicsek F, Thubrikar MJ. Geometric modeling of functional trileaflet aortic valves: development and clinical applications. *J Biomech*. 2006;39:2665-72.
10. Swanson WM, Clark RE. Dimensions and geometric relationships of the human aortic valve as a function of pressure. *Circ Res*. 1974;22:871-82.
11. Vasan RS, Larson MG, Levy D. Determinants of echocardiographic aortic root size. The Framingham Heart Study. *Circulation*. 1995;91:734-40.
12. Aggozino L, Ferraraccio F, Esposito S, Trocciola A, Parente A, Della Corte A, et al. Medial degeneration does not involve uniformly the whole ascending aorta: morphological, biochemical and clinical correlations. *Eur J Cardiothorac Surg*. 2002;21:675-82.
13. Svensson LG, Cooper M, Batizy LH, Nowicki ER. Simplified David reimplantation with reduction of anular size and creation of artificial sinuses. *Ann Thorac Surg*. 2010;89:1443-7.
14. Kouchoukos NT, Milewicz DM, Elefteriades J, Svenson LG, David TE, El Khoury G, et al. Aortic surgery symposium 2010 discussions—session I: aortic root I and session II: aortic root II. *J Thorac Cardiovasc Surg*. 2010; 140(suppl):S45-51.
15. Leyh RG, Schmidtke C, Sievers HH, Yacoub MH. Opening and closing characteristic of aortic valve after different types of valve-preserving surgery. *Circulation*. 1999;100:2153-60.
16. Katayama S, Umetani N, Sugiura S, Hisada T. The sinus of Valsalva relieves abnormal stress on aortic valve leaflets by facilitating smooth closure. *J Thorac Cardiovasc Surg*. 2008;136:1528-35.
17. Fries R, Graeter T, Aicher D, Reul H, Schmitz Ch, Böhm M, et al. In vitro comparison of aortic valve movement after valve-preserving aortic replacement. *J Thorac Cardiovasc Surg*. 2006;132:32-7.
18. Yacoub MH, Gehle P, Chandrasekaran V, Birks EJ, Child A, Radley-Smith R. Late results of a valve-preserving operation in patients with aneurysms of the ascending aorta and root. *J Thorac Cardiovasc Surg*. 1998;115:1080-90.
19. David TE, Maganti M, Armstrong S. Aortic root aneurysm: principles of repair and long-term follow-up. *J Thorac Cardiovasc Surg*. 2010;140:14-9.

Discussion

Dr Tirone E. David *(Toronto, Ontario, Canada).* I have no conflicts to disclose. I commend you, Paul, for these excellent clinical outcomes in patients with a variety of proximal aortic aneurysms with and without aortic insufficiency. Contrary to what your second slide showed, isolated aneurysms of the aortic sinuses do not cause aortic insufficiency. Aortic insufficiency is obviously caused by cusp disease, annular dilatation, and/or sinotubular junction dilation. Isolated sinus of Valsalva aneurysm causes no aortic valve dysfunction.

I believe your method to treat patients with dilated aortic sinuses is reasonable, but I am not sure it can be applied to all patients with proximal aortic root disease. The fact that your patients were 63 years old and only 38% had degenerative aneurysms is an indication that you have included a variety of diseases that cause aortic insufficiency and/or aortic sinus aneurysm. Your patient population is composed of a mix of aneurysmal diseases that in my view primarily affected the ascending aorta, and the sinuses became secondarily involved.

Reimplantation of the aortic valve is an operation that was developed to treat patients with aortic root aneurysm with or without aortic insufficiency, and it is used, at least in my hands, mostly in patients with Marfan syndrome, Loeys-Dietz syndrome, or forme fruste Marfan, but the average age of our patients is almost half of yours.

A supra-annular repair of aortic root aneurysm such as the operation you described works very well, just like remodeling works very well; actually, you are doing a modified remodeling, but instead of tailoring a sinus in the end of a graft, you are tailoring the sinuses individually.

I do not think annular dilatation developed in any of your patients. First, your follow-up is too short. It would take much longer than an average of 43 months to see annular dilatation by echocardiography. I have been unable to detect predictors of annular dilatation in young patients in my practice who had the remodeling procedure. We have not seen dilation of the aortic annulus in older patients in whom remodeling such as what you described was done.

I believe that the main reason your results are so good is that you are selecting your patients carefully. In other words, they are patients who have a normal aortic annulus and they are older. It is widely known that the aortic root dilation is usually asymmetrical, and the noncoronary sinus is often the first one to dilate. Actually, in patients with aortic root aneurysms owing to a bicuspid aortic valve, almost invariably the posterior sinus is the first one to dilate. Therefore, if you do not have annular dilatation to start with, whatever technique is used should work well. I believe that remodeling such as you described or remodeling the way Sir Magdi Yacoub described would provide equally good results if the annulus does not dilate.

In your series, only 9 patients had Marfan syndrome. How many patients in your series were younger than 30 years of age, and were they operated on because of degenerative aortic root aneurysm or other disease?

Dr Urbanski. Thank you for the kind comments, Tirone. I completely agree with you that the mean age of our population is a little bit higher than in other reports. Since we do not have a pediatric department in our cardiac center, we do not see many of these young patients. The portion of those who are younger than 40 years is only 10%.

I also agree with you that the number of Marfan patients was very low in our population. However, I do not believe that the share of Marfan patients is a good mark for efficacy of reconstructive aortic surgery, because there is enormous diversity of disease in Marfan patients. Some such patients have changes of all 3 cusps with very low positioned commissures. In my opinion, they are not suitable for repair at all. On the other hand, there are patients such as the patient I demonstrated in my third slide. He was a Marfan patient without aortic regurgitation but with isolated dilation of the aortic root to about 5 cm and an annulus size of 3. I operated on him because he had severe mitral regurgitation. I also remodeled the root, surely with all 3 sinuses. I do not think that any downsizing of this aortic root would have been a good solution because an overcorrection of the valve with a very good coaptation height of about 1 cm could lead to shrinkage of the cusps. I think that in such cases remodeling is a good solution, because without surgery the natural progression would lead to irregular dilatation of the

sinuses in all directions and to secondary changes of the cusps, with tension along the free margin and with secondary fenestrations or the development of fibrous folds. A repair of sinuses in such patients prevents the progression and the occurrence of events.

However, what we meet in our everyday surgical life are not Marfan patients. Instead, we see patients about 50 or 60 years old with degenerative disease, with hypertension, with more or less pronounced cusp disease. This is the disease that I aim to address with the particular technique I developed. The effect of this technique is that I repaired 100 aortic valves last year and expect 150 this year.

Dr David. That is wonderful. Unfortunately, the title of your paper is misleading, that a supraannular repair solves all problems of the patient with aortic root aneurysm. It does not, particularly in young patients in whom the annulus can dilate, and the bicuspid aortic valve as well. Incompetent bicuspid aortic valve, by and large, is associated with annular dilation.

You had to repair the aortic cusps in 106 patients, or 45% of them, which is similar to our results. You augmented the height, or changed the cusps, in 68 instances and reduced the annulus with subcommissural plication in 15. Subcommissural plication is an annuloplasty. You reinforced the free margin in 12 and plicated the central portion in 25, a total of 128 repaired cusps. So more than half of your patients had repaired cusps, and repaired cusp was a predictor of a bad outcome. It has not been in my hands, it has not been in other hands, and I bet the difference is that we repair cusps concomitant with the reimplantation technique. If you have to replace 1 cusp with pericardium in a 62-year-old patient, isn't it better to replace the whole valve with a pig valve? Newer pig valves last 15 to 20 years in most 63-year-old patients.

Dr Urbanski. Actually, what I do is not augmentation. I normalize the previous shape and size of the cusp, because I use the natural frame of the cusp consisting of free margin, the commissures, and the annulus. I am completely aware that durability of autologous pericardium is limited, but the same is true for the native cusps. If the cusps are changed, shrunk, and have fibrous folds or other pathologic conditions and if you leave such cusps in place, you can also expect recurrent regurgitation. Gebrine (Dr El Khoury) demonstrated 1 year ago a population with the complex aortic valve and root reconstruction, and in his group only 85% of patients had freedom from aortic regurgitation of greater than 2+ at 5 years. I think it is well comparable with our results.

In general, I do not expect a lifelong solution for such valve repairs, but I believe we are offering a solution for maybe 10 to 15 years.

Dr David. That is my point. Is this procedure better than a tissue valve? Surgeons who do not do 150 aortic valve repairs per year may serve their patients better by replacing the valve with a porcine bioprosthesis.

Finally, more a comment than a question: With a mean follow-up of only 3.5 years, one has to be a bit more cautious about interpretation of the results. When I introduced aortic valve–sparing operations, I thought that we could use both reimplantation and remodeling without differences in outcomes. It took us 10 to 12 years of follow-up to see dilatation of the root after remodeling of the aortic root. Dilation of the annulus does not occur overnight in a bicuspid aortic valve or in patients with aortic root aneurysm. Therefore, 3.5 years is really intermediate results.

Dr Urbanski. I agree completely. I will follow my patients and come back in 5 years to report again to this Association. Thank you very much.